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## THE POST-MORTEM IMBIBITION OF POISONS, MORE ESPECIALLY IN ITS MEDICO-LEGAL RELATIONS.<sup>1</sup>

IN the number of the Philadelphia Medical Times for August 19th 1876, the very pertinent question is proposed by a correspondent, whether the embalming a dead body by means of a solution of arsenic, injected into the arteries, might not be the means of arresting the arm of justice in a case where the death had been occasioned by poisoning with arsenic? For, as the querist very properly observes, the art of the toxicologist would be of no avail under the circumstances in detecting the poison in the tissues after death, inasmuch as its presence there could satisfactorily be ascribed to imbibition or soaking of the embalming fluid employed.

The above query has suggested to me the propriety of examining into this subject a little farther; and its consideration has seemed to be of sufficient interest and importance to justify me in bringing it briefly to your notice.

The *post-mortem imbibition of poisons*, or the possibility of the absorption of a poison into the body after death, is a question of very considerable medico-legal importance, as will be seen on a slight examination. In order properly to appreciate its toxicolog-

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<sup>1</sup> A paper read before the College of Physicians of Philadelphia, by JOHN J. REESE, M. D., Professor of Medical Jurisprudence and Toxicology in the University of Pennsylvania.

ical bearing, it will be requisite to refer to two or three preliminary propositions.

The first of these is that a poison is *active*, *i. e.*, is producing its deleterious effects, only whilst it is circulating in the blood; or, to express it differently, the actual, potential *dose* of the poison is that which is circulating, dissolved, through the blood-vessels. All the balance of the poison, however large the quantity may be, remaining either in the stomach, or separated by, and contained in, the organs and tissues, is totally inert *for the time being*; so that if an ounce of arsenic, or of morphia, for example, be swallowed, the real toxic effect is due solely to the comparatively minute quantity—a few grains of either—which has undergone solution, and has been absorbed into the blood. There is one exception only to the above law, in the case of the true corrosives, such as the mineral acids and the caustic alkalies; these, as is well known, produce a direct, destructive action upon the tissues with which they come in contact, by virtue of their chemical affinities.

Another proposition, to which I must refer, is the now well-ascertained fact, that no sooner does the absorbed poison find its way into the circulation than provision is made for its speedy separation and elimination through the medium of the different organs and tissues, more especially the liver, kidney, spleen, heart, and sometimes the brain and spinal cord; and many of these noxious agents—the mineral poisons particularly—may be readily discovered soon after their administration, in the different secretions of the body, notably in the urine, but likewise in the bile, saliva and sweat.

It is farther to be remembered that, when the absorbed poison has thus been separated by the different organs, it is not retained by them for an indefinite length of time; but it disappears, or is re-absorbed, in a period varying both according to the kind of poison employed, and also according to the organ involved. For the knowledge of this important toxicological fact we are indebted chiefly to the researches of the two Orfilas, and likewise to Prof. A. S. Taylor. Thus, to take a single illustration, *arsenic* makes its appearance in the human liver, and has there been detected by analysis, in four hours after that poison has been swallowed. Doubtless it reaches the liver much earlier than this, but as death from arsenical poisoning is not apt to occur in man within a shorter period of time than four hours, no opportunity has hitherto occurred of proving the fact in the human subject. Some experiments on

the lower animals go to show that arsenic is very completely diffused throughout the body in one hour and a half after being introduced.

The human liver acquires its maximum of saturation, in the case of arsenic, in about fifteen hours after the ingestion of this poison; and the quantity thus separated, and capable of demonstration by the analyst, rarely ever exceeds two grains. After this period, the amount discoverable gradually diminishes; thus in ten days it was found to be only 1.5 grains; in fourteen days, 0.17 grains; and in seventeen days, none at all; it had by that time been entirely re-absorbed. (Taylor.)

The generally received opinion is, in relation to arsenic, that, if an individual poisoned by this substance survives for sixteen or eighteen days, and then dies, there will be little, if any, probability of detecting the poison in the liver after death. But, inasmuch as the vast majority of such cases of poisoning prove fatal within eighteen hours, the toxicologist has nearly always the opportunity (which he should never neglect) of discovering the metal in the liver and other organs of the body.

This leads me to allude to a third proposition, which naturally follows from the two preceding ones, viz., that one of the very strongest proofs of death by poison, and the one which especially engages the skill of the analyst, is, *not* the detection of the alleged poison in the stomach (since there may be always a possibility of its having been designedly introduced there after death), but its discovery in the absorbed state, in the liver, kidneys, spleen and other organs; the presumption amounting almost to an absolute certainty that the noxious substance thus detected was administered during life and while the blood-circulation was going on.

Keeping then in mind the important medico-legal fact that the discovery by the toxicologist of the absorbed poison in the tissues and organs of the deceased is regarded as irrefragable proof that the said poison was administered *during life*, it becomes a most interesting and important subject of inquiry: is it possible for a poison to get access within a human body *after death*, and produce appearances in that body similar to, if not identical with, those resulting from swallowing the same poison during life?

It will be obvious, on a moment's reflection, that if the affirmative of this proposition can be maintained, a very strong point in legal medicine will be made; since what has heretofore been regarded

as one of the firmest pillars of evidence for the prosecution, in certain cases of poisoning, will be shaken, and a powerful weapon will be placed in the hands of the defence, which may be wielded by a skilful counsel either for good or evil.

Let us now, for a few moments, examine what are the actual facts of the case. There are only two methods by which a dead human body can receive a poison into itself; one, the *accidental*, as when after burial in a soil that may chance to be impregnated with a poisonous material, in process of time, owing to the decay and disintegration of the coffin, the animal remains come into immediate contact with the poisoned soil; the other method, the *intentional*, where the poison in solution has been purposely introduced through the œsophagus into the stomach, or into the rectum, or hypodermically into the cellular tissue, or finally into the blood-vessels (as in the process of embalming, so called).

As regards the former of these methods, very little need now be said. Prior to the time of Orfila, the opinion generally prevailed that the contamination of a dead body, more especially by arsenic, in the soil of a cemetery, was quite possible; hence we find that this idea was very often urged as a plausible ground of defence, in cases of alleged poisoning by arsenic. This theory has, however, long since been abandoned, for the very sufficient reason that, in the few actual cases in which arsenic has been discovered in cemetery soils, it has invariably existed in the *insoluble* state, generally in combination with either iron or lime. Indeed it cannot be extracted from such soils even by boiling water, but the agency of hydrochloric acid is required to render it soluble; consequently, it is impossible that arsenic should be capable of transudation from soil into a dead body. No sane man would, at the present day, dream of advancing such a plea in the defence of a case of alleged poisoning by arsenic.

But the second method by which a dead body may be impregnated with a poison, and which I have named the *intentional*, is by no means so easily disposed of. The question here is, whether it is possible for a poison existing in the stomach at the time of death (and the death not necessarily due to the poison), or introduced into it after death, to be diffused throughout the body by imbibition, so as to be discovered *in the organs* by chemical analysis? The all-important point, you will observe, is the discovery of the poison *in the organs*, under these circumstances. My reply to this question

is that such a result is most certainly possible ; and that it is easily explained on the well known physical law of *osmosis*.

Orfila was, I believe, the first to actually demonstrate the fact upon dead human and animal bodies, with solutions of arsenic, corrosive sublimate, antimony and copper. His experiments clearly show that, when these solutions are injected into the stomach or rectum, after death, an imbibition does actually take place slowly and gradually through the coats of these viscera into the neighboring organs ; affecting first and chiefly (as might naturally be expected) those viscera which are in immediate juxtaposition with the stomach or rectum, and for the most part limiting its action to the nearest surface of the organ. Thus, for example, a poisonous solution, placed in the stomach after death, would gradually escape through its walls by osmosis, affecting first the contiguous viscera, as the lower surface of the liver, the left under side of the diaphragm, the right side of the spleen, the transverse colon, the omentum, and, still later, the lower lobes of the lungs, the upper surface of the diaphragm, the kidneys and other viscera.

It certainly needs no argument to show how easily the legal physician might be deceived in a case of this character, mistaking the effects of a simple imbibition or soaking of a poisonous solution which had been introduced designedly into the stomach or rectum *after* death, and of course totally disconnected with the death ; and very naturally attribute the results to poison really absorbed during life, and regard them therefore as affording unquestionable proof of the alleged crime. Orfila himself puts this matter very pointedly : “ Suppose,” says he, “ that some wretch, with the design of accusing an innocent person of the crime of poisoning, should introduce into the digestive canal of the dead body a poisonous solution, which would afterwards penetrate by imbibition even to the remotest organs, from which it would be subsequently extracted by the experts, and would lead them to the conclusion that they were dealing with a veritable case of poisoning !”

I suppose that enough has been said to demonstrate at least the fact that the post-mortem imbibition of poisons is not only a possible thing, but also one of comparatively easy accomplishment. Nevertheless, in all the annals of poisoning, which have been marked by so many subtle and crafty machinations, including the mysteries of the secret poisonings of a Toffana, a Borgia, and a Brinvilliers, no mention whatever is made of any attempt of this kind, by which

this odious crime has been sought to be fastened upon an innocent person. Indeed, while Orfila fully admits the possibility of the crime, he distinctly asserts that, to his knowledge, "such a refinement of human wickedness had never been brought before the tribunals of any country," and Sir Robert Christison remarks: "Although I have never been able to find any authentic instance of so horrible an act of ingenuity having been perpetrated, it must nevertheless be allowed to be quite possible."

About five years ago, a remarkable case of alleged poisoning by arsenic occurred in one of our Western states, in which the suspicions were exceedingly strong that the poison had been thus designedly introduced after death, for sinister purposes. The deceased was an aged man, who had been treated in his last illness for phthisis; his physician subsequently testifying to his having died of this disease, and to his having presented none of the symptoms of arsenical poisoning before death. The body had been buried some three or four years, during all of which long interval of time no suspicion of foul play appears to have been entertained. In the meanwhile the widow married again; after which, for reasons not known to me, but believed to be dependent on questions of inheritance of the property of the deceased, the suspicion of poisoning was bruited about, the woman was accused of the crime, and the body was exhumed for judicial examination. The autopsy revealed a remarkable state of preservation of the body—a circumstance of itself well calculated to sustain the suspicion of arsenical poisoning; and, as if to remove all shadow of a doubt, this poison was actually detected in the stomach and liver by a distinguished chemist.

Now one would say that here, surely, was a very strong case; could there be any doubt about it? There was the remarkable preservation of the body for over three years, evidently due, as it seemed, to some antiseptic agent; and then further, there was the actual discovery of the deadly substance, not only in the stomach, but in the liver—showing, it might be urged, that the poison must have been absorbed during the life of the individual.

What then was the ground of the defence to refute these two strong points of the prosecution? First, as to the preservation of the body, it is well known that many instances of remarkable resistance to putrefaction occur in dead bodies, without the presence of arsenic; whilst it is equally well established that arsenic does not always prevent even the rapid decomposition of a body. So

that this point amounts merely to a suspicion, and to nothing more. Moreover, in this connection, the liver is stated to have been "very much broken down." Now, inasmuch as there seems to be, so to speak, a remarkable affinity for arsenic by the liver (a large part of absorbed arsenic being invariably found in this organ), we should naturally expect that the conservative influence of the antiseptic would have been exerted specially upon the liver, if the arsenic had in very truth been absorbed into it during life. In my own experience, in such cases the liver has always exhibited a remarkable degree of firmness even years after death. I therefore regard the "broken down" condition of the liver in this case as a circumstance making against the idea of ante-mortem poisoning.

Another significant fact is, that no mention is made of the discovery of any yellow sulphide of arsenic in the disinterred body. It is well known that when death has been occasioned by ordinary arsenious acid, this substance becomes changed into the yellow sulphide in the process of decomposition, through the agency of the evolved sulphuretted hydrogen gas. This conversion is very distinct, and may always be looked for, if a sufficient length of time be allowed; and the longer the interval, the more certain and complete the change. Certainly, then, the absence of this appearance after a burial of over three years is a very significant circumstance for the defence. At all events, the defence planted itself firmly on the ground that the poison had been designedly introduced into the body, not very long before its disinterment, with the view of fastening the guilt upon the woman, and thus diverting the estate of the deceased into another channel. I have learned, indeed, that this was the opinion of persons most conversant with the facts of the case. There was certainly a strong motive for this sinister and secret act, and there was sufficient opportunity for accomplishing it, as the body had been buried in a vault; and, as we all know, *motive* and *opportunity* constitute very strong circumstantial proof. A most significant fact, moreover, in connection with this case, is, that it had only a preliminary hearing; it was abandoned by the prosecution before coming up for final trial. This, I presume, would hardly have been the issue if the prosecution had felt sure of its ground. As this case is the only one of the kind on record, so far as I know, we must regard it as of considerable medico-legal importance as a leading one in this line. The only regret is that



many of the particulars are deficient; and I have found it impossible to get at the details.

Impressed with the importance of this subject to the legal physician, I made the suggestion to the class in Medical Jurisprudence at the University of Pennsylvania, at its last session, that some of the students should take up the topic as the basis of an experimental thesis, with a view of securing the annual prize instituted by one of the Alumni Societies. I feel a gratification in saying that one member of the class did make a very complete series of experiments in this line, extending over a period of three months, upon the bodies of dogs. At my suggestion, he confined his experiments, for the time, to three poisons—arsenic, tartar emetic, and corrosive sublimate, injecting strong solutions of these mineral substances into the stomachs of the dead animals; then burying them beneath the ground; and disinterring them at different periods of time, so as to note the difference of result, as dependent on the length of time of burial.

From this very interesting essay of Dr. George McCracken, of Philadelphia, I extract the following brief particulars bearing on our subject:—

“The periods of interment were respectively twenty-one, thirty-seven, forty-four and fifty-nine days.

“After twenty-one days’ burial, in the case of all the three poisonous solutions, on opening the abdomen of the animal, the characteristic colored spots of the respective sulphides were observed on the spleen, the under surface of the liver, and the portion of peritoneum posterior to the stomach—*yellow* colored in the case of arsenic; *red* in the case of antimony; and *black* in the case of mercury. Each of these metals was likewise discovered by chemical analysis in the liver, spleen and left kidney; the order for the greatest amount of the poison detected being first in the spleen, next in that part of the liver nearest the stomach, then in the left kidney, then in that part of the liver farthest from the stomach, and none in the right kidney.

“After forty-four days’ burial, the deposit of the different sulphides was found to be much more decided in all three cases, being noticed on the upper as well as on the lower surface of the liver, together with the spleen (as in the first experiment); also over the intestines, the omentum and the kidneys; and, in the case of the

arsenic, extending as low down as the fundus of the bladder. By chemical analysis, the poisons were detected in the spleen, liver and both kidneys.

“After fifty-nine days’ burial, the results were found to be very similar to those last detailed, only more decided, both as regards the quantity deposited on the various organs, in the form of sulphides, and that discovered by chemical analysis.”

From his experiments, thus epitomized by me, Dr. McCracken deduces the two following conclusions: First, if a solution of either arsenious acid, tartar emetic or corrosive sublimate (and this is doubtless true of all other metallic solutions, and presumably true of the organic poisons likewise), be injected into a dog’s stomach after death, it passes by osmosis through the coats of this organ into the adjoining viscera, and may be discovered in three weeks (his earliest experiment) by chemical analysis, in the spleen, the liver and the left kidney; but not in the right kidney prior to the fifth week.

I myself think it highly probable that the osmotic action occurs even earlier than this, and that an earlier experiment would have demonstrated the presence of the poisons, in at least some of the contiguous viscera within a still shorter period.

The second conclusion arrived at is, that the arsenic solution penetrates through the stomach more rapidly and completely than the other two substances employed. I am pleased to learn that Dr. McCracken intends to prosecute his experiments farther, upon human bodies, and with various poisonous solutions; but I cannot doubt that the results must be similar to those I have just detailed, inasmuch as these are dependent upon a great physical law, which operates in a precisely similar manner upon the dead tissues of man and those of the lower animals.

In summing up this whole matter, the really important practical question to be settled is this—and it is one of vital medico-legal interest: Is it possible, in an unknown case of poisoning, where the whole issue depends on the chemical discovery of the poison in the tissues of the body, to distinguish between poison really *absorbed* during life, and that which has been merely *imbibed* after death? Of course, I put out of the question all the other collateral evidences, such as the symptoms before death, the post-mortem lesions,

together with the moral or circumstantial proofs in the case. Can the distinction be positively made?

My reply is this: If I had the opportunity to make a careful comparative analysis of the *interior* of the organ, the liver, for example, with the exterior of the same organ—especially if the examination were made not long after death—and I discovered the poison in the interior as well as on the external part of the organ, I should be disposed to regard it as evidence of really absorbed poison, inasmuch as a substance absorbed into the blood during life would unquestionably find its way through the route of the circulation into the most interior recesses of an organ, and would not be confined to its exterior merely; whereas, if it had simply leaked out of the stomach or rectum after death, it would be far more likely to be discovered on, or near the surface of, the contiguous viscera, than deep down in the interior of their structure.

But, on the other hand, if the poison were found on the exterior of the organs only, and not in their interior, after a careful research, I should regard it as a true case of post-mortem imbibition. Or, at least, presuming it to be such, I should direct my investigations accordingly.

Some recent experiments of M. Scolosuboff, of Moscow (*Archives de Physiologie*, No. 5, Août et Septembre 1875), go to show that, in dogs and rabbits poisoned by arsenic, this substance is deposited in the brain and spinal marrow in far larger quantities than in the liver and other organs. Comparative analyses of equal weights of muscle, liver, brain and spinal marrow, taken from a dog that had been fed on arsenic for five weeks, demonstrated that the brain and spinal marrow contained thirty-six and thirty-seven times the amount found in the muscles, and nearly four times that discovered in the liver. In acute poisoning (the animal dying in seventeen hours), the brain was found to contain rather more than the spinal cord.

From the close resemblance of some of the symptoms of arsenical poisoning—*e. g.*, the local paralysis and muscular atrophy—with those produced by lead, and from the fact that this latter metal had been discovered, after death, in the great nerve centres, it might have been inferred that arsenic would also be deposited in these organs; but M. Scolosuboff is, I believe, the first to have made the actual demonstration in the lower animals. I am not aware that it

has yet been verified in man, although there seems good reason to believe that it will equally apply to the human subject. Should this prove to be the fact, we shall be in possession of a positive and unequivocal chemical method of distinguishing between ante-mortem and post-mortem poisoning by arsenic (and probably by other metals), by the detection of the poison in the brain and spinal cord; since it is scarcely conceivable that a poison, introduced into a body after death, could penetrate by imbibition within the cavity of the cranium or spinal column. At all events, it will henceforth become the duty of the expert, in all doubtful cases, to extend his researches for the poison to the brain and spinal cord.

After all, however, cases may occur of a complicated character, which on the trial may give rise to painful doubts, and in which, as I before remarked, a skilful advocate might employ these ascertained facts with considerable ingenuity, either for or against the cause of truth. As the result of some experience and considerable reflection on this subject, it is my deliberate opinion, that in a trial for the capital crime of poisoning the defence has the undoubted right to demand, on the part of the chemical expert who has conducted the analysis of the body of the deceased, not merely proof of the detection of the alleged poison in the stomach, nor even proof of its discovery in the organs and tissues of the body, but, even farther than this, evidence, clear and unmistakable, of its detection in the *interior* of these organs; and farther still—from what we now know—in the brain and spinal cord. Of course I am aware that the guilt of the prisoner may sometimes be established quite independently of the chemical analysis, but with that point we have nothing to do at present; I am now discussing this chemical evidence exclusively; and I would here repeat, what I have elsewhere asserted, that, inasmuch as upon this very chemical evidence may be suspended the momentous issue of the life or death of a fellow being, nothing should be accepted from the expert as testimony but a demonstration of his discovery so clear, so searching and so unequivocal as to suggest to the mind no shadow of a doubt.

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